

SNS BLM SYSTEM REQUIREMENTS



- BLM system will be “Project-wide”
 - How will 1 W/m dose rate differ in Linac, HEBT, Ring?
 - Do we want uniform 1 W/m or uniform % beam loss in Linac?
- Need input from Physics and Operations
 - Losses shown in Sasha’s Table good start but now need more details
- Need to establish parameters **NOW** for
 - Commissioning (Physics)
 - Studies (Physics and Operations)
 - Normal Operations

BLM SYSTEM DESIGN QUESTIONS



- System design philosophy
 - Types of losses trying to protect against
 - Slow, long-term low level losses (1 W/m)
 - Estimate of Losses
 - Software Alarm?
 - Fast, high level losses
 - Specify upper end of linear range
 - Specify threshold resolution (8-bits ?)
 - Nature of threshold programmability
 - » Inter-pulse or intra-pulse

Questions for Physics



- Special requirements for studies
 - What is required minimum resolution?
 - 1% of 1 W/m (1 GeV) with a few Hz BW should be achievable
 - What is required time response?
 - A few Hz for low level losses, ~ 50 kHz for fast losses (Note: Losses within Mini-bunch monitored with separate PMTs)
 - Masking capability to allow wire scanners and other planned high losses
 - What data rates will be required for studies?
 - Lower REP rate may allow full data readback in non-real time

Questions for Operations



- Normal requirements imposed by Operations ?
 - Machine Protection
 - What type of alarm for Slow, Fast loss?
 - Interface for Beam Inhibit (individual BLMs or single output per crate?)
 - Resolution of Loss threshold detection (N-bits)
 - Do we require dynamic threshold change in Ring during accumulation?
 - Response time
 - Data Logging
 - Number of channels
 - Update rate
 - Comfort displays
 - “Scope” displays

BASIC BLM SYSTEM CONFIGURATION



- Same detectors, electronics throughout SNS
- Ion chambers will be basic detector for calibrated measurements and Beam Inhibit
 - Linac..... 100
 - DTL = 12,
 - CCL = 24,
 - SRF = 64
 - HEBT..... 40
 - Ring..... 107
 - RTBT..... 57
- Ion chambers will be located at most quads
- Gain change capability to account for expected high loss areas
- Is real-time gain change required?
- Photo-Multipliers for fast bunch measurements

DOSE RATES LIMITS



- Slow Loss: 1 W/m limit
 - Corresponds to $\sim 10^{-4}$ distributed around 248 m Ring or 4×10^{-7} of total beam lost per meter
 - Gives 60-100 mrad/hr at 1 ft beam-off activation
 - “Rule of thumb”: Multiply by 1000 to get corresponding average dose rate during beam on
 - Need to resolve 2 decades below this to reasonably measure 1 W/m (4×10^{-9} of total beam/meter)
- What is maximum Fast (high-end) loss?
 - If we take 1% lost at a single point the total range is 2.5×10^6 , equivalent to 21-bits + sign
 - May want several bits higher to not saturate ADC
- Low-end resolution limited by noise and BW, upper end by detector or electronics saturation (BLM expected to show effects at 5-10% loss)

EXPECTED LOSSES



- HEBT, Ring and RTBT designed to have collimators as limiting apertures
 - Can we have any losses at other points?
 - Gas stripping
 - Linac RF (HEBT losses)
 - First turn injection mis-steering
 - Kicker misfire
 - HEBT, RTBT steering mis

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